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(57) Abstract

An agricultural concentrate is disclosed for mixing with spray water prior to addition thereto of an agricultural–chemical. The concentrate visually indicates when the agricultural chemical has been added to the spray water in a desired amount and at a desired pH. The concentrate comprises an ingredient for adjusting the quality of the spray water, and a pH indicator.

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AGRICULTURAL COMPOSITIONS COMPRISING A PH INDICATOR

FIELD OF THE INVENTION

The present invention relates to concentrates for improving the activities of agricultural chemicals, and more specifically to concentrates which visually indicate when the spray water of an agricultural composition contains an effective concentration of an agricultural chemical at a pH at which the agricultural chemical has acceptable agricultural activity. The present invention also relates to methods for preparing agricultural compositions containing such concentrates.

BACKGROUND OF THE INVENTION

Modern agriculture makes widespread use of agricultural compositions for application to crops, soil and animals. These agricultural compositions are typically formed by combining water with an agricultural chemical selected from pesticides, including insecticides, nematodicides, molluscicides and rodenticides; fungicides; and herbicides.

The water used to prepare agricultural compositions, sometimes referred to herein as "spray water", varies widely as to source and quality. For example, the water may originate from a natural surface or subsurface source or may be municipally treated water. Such water may contain varying amounts of impurities such as mineral

salts and suspended colloidal particles, and may vary widely in pH. However, the pH of most agricultural water supplies tends towards alkalinity, i.e. pH greater than 7.0.

It has been found that the activity of agricultural chemicals is affected by water pH and by the impurities found in water. For example, most agricultural chemicals have optimum effectiveness and stability at an acidic pH, typically within the range of 4 to 6. Many agricultural chemicals are rendered ineffective by alkaline hydrolysis when mixed with water having an alkaline pH. The severity of alkaline hydrolysis is dependant on the pH of the water, the relative susceptibility of the agricultural chemical, the time of exposure and the condition and temperature of the water. Most significantly, the rate of hydrolysis increases with increasing pH such that, at a pH above about 8, many agricultural chemicals have a half life of from a few minutes to a few hours.

Water containing high concentrations of mineral salts such as calcium and magnesium carbonates, calcium and magnesium sulfates and sodium bicarbonate, referred to herein as "hard" water, also has a detrimental effect on activities of agricultural chemicals. For example, high salt concentrations in the water with which an agricultural chemical is mixed can lead to precipitation of the agricultural chemical, rendering it ineffective. Hard water has other, less well understood, effects on agricultural chemicals which also affect activity. For example, the agricultural chemical may form chelates with certain cations in the water. Antagonism caused by

mineral salts has been found to have a particularly adverse impact on herbicides.

Although there is no direct relationship between water pH and water hardness, hard water generally has an alkaline pH. Therefore, if the amounts of certain dissolved mineral salts in hard water is reduced, for example by the formation of insoluble salts which precipitate from the solution, a reduction in the pH will generally also be observed.

Therefore, spray water must typically be treated in order to preserve the activity of the agricultural chemical with which it is to be mixed. Such treatment typically comprises reducing the antagonistic effects of aqueous mineral salts in the spray water and/or adjusting its pH. For example, pH adjusting agents such as acids, bases and buffers are usually added to the water prior to mixing with the agricultural chemical to ensure that the water is at a pH which will not adversely affect the activity of the agricultural chemical.

The pH adjusting agent may be in the form of a concentrate which contains an agricultural adjuvant for enhancing the activity of an agricultural chemical in an aqueous composition. The adjuvant is typically a pH modifying agent selected from acids, bases and buffers. The adjuvant may be present in the concentrate in combination with a number of other ingredients such as solvents, spreaders, wetters or the like.

One such concentrate is disclosed in U.S. Patent No. 5,278,132 to Fisher et al.,

issued on January 11, 1994, and incorporated herein by reference. The concentrate disclosed by Fisher et al. contains a pH modifying agent and is added to water prior to addition thereto of an agricultural chemical.

The Fisher et al. concentrate also contains a pH indicator which changes the colour of the water when the pH of the water is within the range at which the activity of the agricultural chemical is highest, typically within the range of 4 to 6. Therefore, the Fisher et al. concentrate provides a simple method for quickly and easily determining when sufficient concentrate has been added to the water.

After the Fisher et al. concentrate has been added to the water, a measured amount of an agricultural chemical may be added to the pH-adjusted water to provide an agricultural composition having a predetermined concentration of the chemical. However, in order to provide the desired concentration with any degree of precision, the person mixing the composition must accurately measure the amount of agricultural chemical being added, and must also know the volume of the water to which the chemical is being added. This degree of precision is often difficult to attain under the conditions in which agricultural compositions are prepared.

Therefore, one disadvantage of the Fisher et al. concentrate is that it requires an accurate determination of the concentration of the agricultural chemical in the agricultural composition. Failure to accurately measure the concentration can result in waste of agricultural chemicals, damage to crops or animals, and reduced effectiveness

of the agricultural chemical.

Another disadvantage of the Fisher et al. concentrate is that, even if the concentration of the agricultural chemical in the composition is accurately determined, the use of hard water containing large amounts of dissolved mineral salts may lead to a reduction in agricultural activity of the agricultural chemical. Therefore, use of the Fisher et al. concentrate does not ensure that the agricultural chemical is present in the composition in an agriculturally effective amount.

SUMMARY OF THE INVENTION

In order to overcome the above-discussed problems with prior art concentrates, the present invention provides a concentrate to be mixed with water prior to addition thereto of an agricultural chemical. The concentrate according to the invention treats the spray water by reducing the antagonistic effect of aqueous mineral salts present dissolved therein and/or adjusting its pH, and also visually indicates when a desired amount of an agricultural chemical has been added to the spray water at a pH at which the agricultural chemical has acceptable agricultural activity.

The concentrate according to the present invention therefore comprises:

1. an active ingredient selected from one or more members of the group comprising pH modifying agents and water conditioning agents; and
2. a pH indicator for colouring water.

The concentrate is preferably added to the spray water in a predetermined amount prior to addition thereto of the agricultural chemical. The active ingredient in the concentrate adjusts the pH of the spray water and/or conditions the water, for example by binding with ions present in the water which would have an antagonistic effect on the agricultural activity of the agricultural chemical.

The concentrate of the present invention is to be used with agricultural chemicals containing a pH modifying group. Addition of the agricultural chemical to the spray water containing the concentrate therefore changes the pH of the spray water. The pH indicator produces a colour change in the spray water at a pH at which the agricultural chemical has acceptable agricultural activity and at which the agricultural chemical is present in an agriculturally effective concentration.

The concentrate of the invention is preferably used to prepare agricultural compositions containing an agricultural chemical having an acidic functional group and having acceptable agricultural activity at a pH within the range of from about 4 to about 7, more preferably from about 4 to about 6. The agricultural chemical is selected from the group comprising pesticides, including insecticides, nematodicides, molluscicides and rodenticides; fungicides; and herbicides. Most preferably, the agricultural chemical is the herbicide glyphosate and its salts.

The pH modifying agent according to the invention is preferably selected from the group comprising acids, alkalis, buffers and salts for controlling or modifying the pH of water.

In situations where water hardness would detrimentally affect the activity of the agricultural chemical, the concentrate preferably contains a water conditioning agent capable of reducing the effects of hard water on the agricultural chemical. For this purpose, ammonium compounds such as ammonium sulfate are most preferred.

In another aspect, the present invention provides a method for preparing an agricultural composition containing a predetermined concentration of an agricultural chemical having a pH modifying group and having an activity which varies with pH, the method comprising:

a. providing a concentrate comprising a pH indicator and an active ingredient selected from one or more members of the group comprising pH modifying agents and water conditioning agents;

b. mixing the concentrate with a predetermined volume of water to form an aqueous mixture of the concentrate; and

3. forming the agricultural composition by adding the agricultural chemical to the aqueous mixture until the colour change is observed in the composition, wherein the colour change occurs at a pH at which the

agricultural chemical has acceptable agricultural activity, and at an agriculturally effective concentration of the agricultural chemical.

Therefore, it is one object of the present invention to provide a concentrate which, when added to spray water, visually indicates when a desired amount of an agricultural chemical containing a pH modifying group has been added to the water.

It is another object of the present invention to provide a method for preparing an agricultural composition in which a concentrate is added to spray water and visually indicates when a desired amount of an agricultural chemical has been added to the water.

It is yet another object of the present invention to provide a concentrate which is useful for preparing agricultural compositions containing agricultural chemicals having pH modifying groups, and salts thereof.

It is yet another object of the present invention to provide a method for preparing an agricultural composition containing an agricultural chemical which has a pH modifying group, or a salt thereof.

It is yet another object of the present invention to provide a concentrate for preparing an agricultural composition containing glyphosate, wherein the concentrate visually indicates when glyphosate is present in the water in a predetermined concentration and at a desired pH.

It is yet another object of the present invention to provide a method for preparing an agricultural composition containing glyphosate, wherein the concentrate visually indicates when glyphosate is present in the water in a predetermined concentration at a desired pH.

Further aspects and advantages of the present invention will become apparent from the following description of the preferred embodiments.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

Concentrates according to the present invention comprise a pH indicator and an active ingredient selected from one or more members of the group comprising pH modifying agents and water conditioning agents.

Preferred pH modifying agents according to the invention are selected from the group comprising acids, alkalis, buffers and salts for controlling or modifying the pH of water.

Where the water to be mixed with the concentrate is alkaline, that is, has a pH greater than about 7.0, the pH modifying agent is preferably an acid. Preferred acids for use in the concentrate of the invention are selected from the group comprising acetic acid, orthophosphoric acid, citric acid, hydrochloric acid, sulfuric acid, nitric acid and formic acid. However, it is to be appreciated that other acids may preferably be used in the concentrate.

Where the water to be mixed with the concentrate is too acidic, the pH modifying agent is preferably a base. For example, preferred bases for use in the concentrate of the invention are selected from the group comprising ammonia, potassium hydroxide and sodium hydroxide. However, it is to be appreciated that other bases may preferably be used in the concentrate.

In certain circumstances it may be preferred that the pH modifying agent be a buffer. Buffers are capable of not only adjusting the pH of the water to a desired range, but are also capable of maintaining the pH of the water within that range. Preferred buffers according to the present invention are prepared from an acid or base and a salt of the acid or base. Examples of preferred acids are acetic acid, phosphoric acid and propionic acid. Example of preferred buffers include acetic acid and ammonium acetate, acetic acid and potassium acetate, acetic acid and sodium acetate, phosphoric acid and monoammonium phosphate, and phosphoric acid and monopotassium phosphate.

When the water used in the preparation of an agricultural composition is hard water, the water conditioning agent is preferably a compound which reduces the antagonistic effect on the agricultural chemical of dissolved mineral salts in the spray water. Preferred water conditioning agents are selected from the group comprising ammonia or ammonium-containing compounds, citric acid, ethylenediaminetetraacetic acid (EDTA), phosphoric acid,

sulfuric acid, and salts thereof. More preferred water conditioning agents are those containing ammonia or ammonium ion. Particularly preferred water conditioning agents for use in the concentrate according to the invention are Bladbuff™ 5, ammonium sulfate, ammonium nitrite, monoammonium phosphate (MAP) and ammonium bicarbonate, with ammonium sulfate being most preferred.

Although ammonium sulfate is primarily a water conditioner, it also affects the pH of the spray water. In alkaline spray waters, the concentrate of the present invention containing ammonium sulfate typically reduces the pH of the spray water to the range of from about 6 to about 6.5. However, it is to be appreciated that the pH reduction achieved is dependent on the initial pH of the spray water, the ions present in the spray water (i.e. hardness), and the amount of ammonium sulfate added to the spray water.

It is believed that ammonium ion substantially reduces the antagonistic effect of dissolved minerals in water. Although the applicant is not to be bound by theory, ammonium ion may mitigate antagonism by preferentially binding the molecules of the agricultural chemical, thereby preventing the formation of large molecular clusters which are not easily absorbed or translocated. Another theory is that ammonium ion alters the protein structure of the cell wall of the plant onto which the agricultural composition is sprayed, thereby rendering it more permeable to

the agricultural composition. Yet another theory, involving ammonium sulfate, is that ammonium sulfate reacts with dissolved calcium ions to form insoluble calcium sulfate, thereby removing antagonistic calcium ions from solution.

The concentrate according to the invention also comprises a pH indicator for colouring water, the pH indicator producing a visible colour change at a pH at which the agricultural chemical has an acceptable agricultural activity. In the case of agricultural chemicals having acceptable agricultural activity at acidic pH values, the pH indicator preferably produces a colour change in the range of from about pH 4 to about pH 7.

Preferred pH indicators producing a colour change in the range of from about pH 4 to about pH 7 include methyl red, bromocresol purple, bromocresol green, 4-phenylazo-1-naphthylamine, ethyl red, 2-(p-dimethylaminophenylazo)-pyridine, 4-(p-ethoxyphenylazo)-m-phenylenediamine monohydrochloride, lacmoid, alizarin red S, propyl red, chlorophenol red, p-nitrophenol, alizarin and 2-(2,4-dinitrophenylazo)-1-naphthol-3,6-disulfonic acid, disodium salt. More preferred pH indicators used in the concentrate are selected from the group comprising methyl red, bromocresol purple and bromocresol green. It is to be appreciated that other pH indicators may also preferably be used, the choice of pH indicator being dictated by the agricultural chemical in the agricultural composition, the solubility (in water) and toxicity of the indicator, the

sharpness of the colour change, and cost of the indicator.

Methyl red changes from colourless at a neutral pH of 7 (sometimes through a yellow stage) to pink in a pH range of about 5.5 to about 4.5, and to bright red at a pH value of about 4.5 and lower. Methyl red is preferably in its free acid form, such as that sold under the trade mark Colorite™. One preferred formulation comprises a 0.1% m/m solution of methyl red free acid in an isopropyl alcohol solvent.

Bromocresol purple changes from purple at a neutral pH of 7 to yellow through an intermediate green stage in a pH range of about 6.8 to about 4.5, and remains yellow at pH values of about 4.0 to 4.5 and lower. For example, at a pH of about 5.5, a green colour is observed. Preferably, bromocresol purple is dissolved in a solvent to assist its dissolution in acidic solutions. One preferred solvent is propyl alcohol, with the relative amount of bromocresol purple to propyl alcohol being about 5% w/w.

It will be appreciated that the particular pH indicator used in the concentrate is at least partially dependent on the specific agricultural chemical which is ultimately combined with the concentrate in the agricultural composition. For example, where glyphosate is the agricultural chemical, the most preferred pH indicator is bromocresol purple, although methyl red also produces acceptable results. One reason why bromocresol purple is particularly preferred is that it has lower toxicity than

methyl red.

Furthermore, the amount of pH indicator present in the concentrate is sufficient that the indicator will be effective and visible once the concentrate is diluted with water. Therefore, the amount of pH indicator included in the concentrate is related to the amounts of water and agricultural chemical in the ultimate agricultural composition. More specifically, when small amounts of concentrate are added to water, the ratio of pH indicator to pH modifying agent in the concentrate is relatively high, and when large amounts of concentrate are added to water, the ratio of pH indicator to pH modifying agent in the concentrate is relatively low. The manufacturer of the concentrate will be aware of the intended use of the concentrate and will prescribe the concentrations at which it will be added to the spray water. Therefore, it will be a simple matter for the manufacturer to ensure that the concentrate contains sufficient pH indicator to be effective when the concentrate is used at these prescribed concentrations.

Considerable and indeed radical variations in the relative proportions of the pH modifying agent and the pH indicator in the concentrate are thus contemplated by the present invention, and therefore the absolute concentrations of the pH modifying agent and the pH indicator can also vary radically. However, the applicant has found that no difficulty is presented in determining such absolute concentrations and relative

concentrations by means of routine experimentation. The proportions of pH indicator and pH modifying agent may thus vary considerably from one concentrate to another, depending on how much of the concentrate is intended to be added to water.

In a particularly preferred concentrate according to the invention for use with glyphosate, about 5g of a 5% w/w mixture of bromocresol purple and propyl alcohol (containing about 0.25g bromocresol purple) is combined with about 1,000g of ammonium sulfate. In this embodiment, the proportion of bromocresol purple to ammonium sulfate is about 0.025% w/w.

The concentrate may also contain a number of other ingredients such as solvents, spreaders, wetters or the like. Such ingredients are typically employed when the agricultural composition is used for application to plants and/or soil, or spraying or dipping animals.

The concentrate may preferably be in any form which may be conveniently measured, for example a solid or a liquid. In one preferred embodiment, the concentrate contains water as a diluent to facilitate handling and measurement of the concentrate and to dissolve or disperse the various ingredients therein.

After the concentrate is added to spray water in a predetermined amount, an agricultural chemical, or a salt thereof, is added to the spray water to produce an agricultural composition according to the invention. The agricultural chemical is one which will alter the pH of the water to which it

is added, and contains a pH modifying group such as an acidic or basic functional group.

Preferably, the agricultural chemical contains at least one acidic functional group. The agricultural chemical preferably also has an activity which varies with pH and has optimum agricultural activity and stability at an acidic pH. More preferably, the agricultural chemical is one which has optimum agricultural activity and stability within the pH range of from about 4 to about 7, and most preferably within the pH range of from about 4 to about 6.

It may also be preferred to utilize agricultural chemicals which increase the pH of the spray water such as copper hydroxide, lime sulfur, potassium nitrate and bordeaux mixture, which comprises a mixture of hydrated lime and copper sulfate ($CuSO_4$).

The agricultural chemical is preferably selected from the group comprising pesticides, defoliants, desiccants and plant nutrients. The agricultural chemical may preferably be a pesticide selected from the group comprising insecticides, nematodicides, molluscicides and rodenticides, or a fungicide or herbicide. More preferably, the agricultural chemical is selected from one or more members of the group comprising organophosphates, carbamates, benzimidazoles, dicarboxamides, bypyridols, pyrethroids and chlorinated hydrocarbons.

Most preferably, the agricultural chemical is N-

(phosphonomethyl)glycine, known as glyphosate. Glyphosate is a widely used organophosphate herbicide which is believed to penetrate the wax layer (cuticle) of plant leaves and is quickly distributed to the plant roots where it prevents the synthesis of amino acids, eventually causing death of the plant. Preferred glyphosate formulations for use in agricultural compositions according to the invention are available from Monsanto under the trade marks Roundup™ and Sting™.

Glyphosate is an acidic compound having a phosphate group and a pH of about 5.2. The phytotoxicity of glyphosate is not substantially affected by pH within the pH range of from about 2.2 to about 8.0. However, above a pH of about 7.0, the activity and stability of glyphosate are observed to decline. The optimum pH range for glyphosate is from about 4 to about 6, and more preferably from about 4.5 to about 5.5.

Due to its poor solubility in water, glyphosate used in the preparation of agricultural compositions according to the present invention is preferably in the form of an agriculturally active salt. Preferred salts include sodium glyphosate sesquihydrate and the ammonium, trimesium and isopropylamine salts of glyphosate. Most preferably, glyphosate is used as its isopropylamine salt, which is highly water soluble.

It will be appreciated that the concentrate and method of the present invention are applicable to large numbers of

agricultural chemicals and that the concentrations of these chemicals can vary substantially in the eventual agricultural composition for application to crops, soil or animals, depending, inter alia, on the nature of the agricultural chemical itself, the purpose for which it is being used, climatic conditions, the half-life of the agricultural chemical in water of a particular pH, frequency of application, the type of crop, environmental factors and economics, or the like.

A preferred process according to the invention for preparing an agricultural composition will now be described below, utilizing glyphosate as the agricultural chemical and a concentrate containing a ratio of bromocresol purple to ammonium sulfate of about 0.025% w/w, as discussed above.

Firstly, a concentrate is prepared comprising an active ingredient and a pH indicator for colouring water, wherein the pH indicator is capable of producing a visible colour change in the range of pH 4 to pH 7. In the particularly preferred embodiment, the concentrate comprises about 99.5 wt% ammonium sulfate as active ingredient, about 0.02 wt% bromocresol purple as pH indicator, and about 0.47 wt% propyl alcohol as solvent for the pH indicator. This concentrate is preferably in the form of a dry formulation.

The next step in the process is to form an aqueous mixture of the concentrate by mixing a predetermined quantity of the concentrate with a predetermined volume of water. Prior to

addition of the concentrate, the pH of the water is preferably at least about pH 7.0. The concentrate is preferably added into a container containing at least about 95% of the water to be present in the agricultural composition. Typically, the concentrate is added to the water in a concentration of about 2% w/v, although this is variable and at least partially dependent on the hardness and/or pH of the spray water.

The final step in forming the agricultural composition is to mix an agricultural chemical with the aqueous mixture of concentrate and spray water until a visible colour change is observed. At this point, the agricultural chemical is present in the composition in a predetermined concentration and pH.

In the case of the particularly preferred concentrate, glyphosate, most preferably in the form of Roundup™, is added into the aqueous mixture of concentrate until the colour of the water changes from purple to green/yellow, at which point the pH will be less than or equal to about pH 5.5. Typically, the pH after the colour change will be within the pH range of from about 4.5 to about 5.5, preferably about 5.2.

In one preferred example, an amount of concentrate containing about 1 to 3 kg, preferably about 3 kg, of ammonium sulfate is added to about 100 litres of water. After addition of the concentrate, the water is purple.

Next, about 2 litres of Roundup (having a glyphosate

concentration of 360g/litre) is added to the water containing the concentrate. This is the minimum amount of Roundup recommended per hectare. If the addition of 2 litres of Roundup does not turn the water yellow, addition of Roundup is continued until the water turns yellow or the maximum recommended amount of Roundup is added to the water. The maximum amount of Roundup recommended per hectare is 4 litres. Preferably, the amount of Roundup added to the spray water does not exceed 4 litres per hectare.

Although the invention has been described in connection with certain preferred embodiments, it is not intended to be limited thereto. Rather, it is intended that the invention cover all alternate embodiments as may be within the scope of the following claims. The invention also includes all embodiments which are functional equivalents of the specific embodiments and features which have been described herein.

It will be further understood that, although various features of the invention have been described with respect to one or another of the embodiments of the invention, the various features and embodiments of the invention may be combined or used in conjunction with other features and embodiments of the invention as described herein.

What is claimed is:

1. A concentrate for enhancing the activity of an agricultural chemical having a pH modifying group, comprising:

1. an active ingredient selected from one or more members of the group comprising pH modifying agents and water conditioning agents; and

2. a pH indicator for colouring water, the pH indicator producing a colour change in water at a pH at which the agricultural chemical has an acceptable agricultural activity;

the concentration of pH indicator in the concentrate being sufficient that, when the agricultural chemical is added to spray water containing a predetermined amount of the concentrate, the pH indicator produces a visible colour change in the spray water after addition of an agriculturally effective amount of the agricultural chemical.

2. The concentrate according to claim 1, wherein the pH modifying group of the agricultural chemical is an acidic group and wherein the pH indicator produces a visible colour change in the range of from about pH 4 to about pH 7.

3. The concentrate according to claim 2, wherein the pH indicator is selected from the group comprising methyl red, bromocresol purple, and bromocresol green.

4. The concentrate according to claim 1, wherein the pH modifying agent is selected from the group comprising acids, alkalis and buffers for controlling or modifying the pH of water, and the water conditioning agent is a compound which reduces the antagonistic effect on the agricultural chemical of dissolved mineral salts in the spray water.

5. The concentrate of claim 4, wherein the water conditioning agent is an ammonium salt.

6. The concentrate of claim 5, wherein the ammonium salt is ammonium sulfate.

7. The concentrate according to claim 1, wherein the concentrate is in the form of a powder.

8. A concentrate for enhancing the activity of an agricultural chemical selected from the group comprising glyphosate and salts thereof, the concentrate comprising:

1. ammonium sulfate; and

2. a pH indicator for colouring water, the pH indicator producing a colour change at a pH of from about 4 to about 7;

the concentration of pH indicator in the concentrate being sufficient that, when the agricultural chemical is added to spray water containing a predetermined amount of the concentrate, the pH indicator produces a visible colour change in the spray water after addition of an agriculturally effective amount of the agricultural chemical.

9. The concentrate according to claim 8, wherein the pH indicator is selected from the group comprising methyl red, bromocresol purple, and bromocresol green.

10. A method for preparing an agricultural composition containing an agricultural chemical having a pH modifying group and having an activity which varies with pH, the method comprising:

1. providing a concentrate comprising a pH indicator and an active ingredient selected from one or more members of the group comprising pH modifying agents and water conditioning agents;

2. mixing the concentrate with a predetermined volume of water to form an aqueous mixture of the concentrate; and

3. forming the agricultural composition by adding the agricultural chemical to the aqueous mixture until the colour change is observed in the composition, wherein the colour change occurs at a pH at which the agricultural chemical has acceptable agricultural activity, and at an agriculturally effective concentration of the agricultural chemical.

11. The method according to claim 10, wherein the pH modifying group of the agricultural chemical is an acidic group and wherein the pH indicator produces a visible colour change in the range of from about pH 4 to about pH 7.

12. The concentrate according to claim 11, wherein the pH indicator is selected from the group comprising methyl red, bromocresol purple, and bromocresol green.

13. The method according to claim 11, wherein the agricultural composition containing the predetermined concentration of the

agricultural chemical has a lower pH than that of the aqueous mixture prior to addition thereto of the agricultural chemical.

14. The method according to claim 10, wherein the agricultural chemical is selected from the group comprising glyphosate and salts thereof.

15. The method according to claim 11, wherein the pH modifying agent is selected from the group comprising acids, alkalis and buffers for controlling or modifying the pH of water, and the water conditioning agent is a compound which reduces the antagonistic effect on the agricultural chemical of dissolved mineral salts in the spray water.

16. The concentrate of claim 15, wherein the water conditioning agent is an ammonium salt.

17. The concentrate of claim 16, wherein the ammonium salt is ammonium sulfate.

INTERNATIONAL SEARCH REPORT

Inte ,onal Application No
PCT/CA 98/01066

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 A01N25/00 A01N57/20

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 A01N

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5 278 132 A (FISHER JONAH ET AL) 11 January 1994 cited in the application see column 1 - column 2, line 31 see column 3, line 8 - line 41 see column 3, line 46 - line 68; examples	2-6,8, 10-14, 16,17
A	GB 1 424 714 A (COLGATE PALMOLIVE CO) 11 February 1976 see page 1, line 18 - line 56 see page 2, line 10 - line 19 see page 2, line 61 - line 70	2-18

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
11 March 1999	29/03/1999

Name and mailing address of the ISA	Authorized officer
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INTERNATIONAL SEARCH REPORT

Information on patent family members

Inte. onal Application No
PCT/CA 98/01066

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